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The Role of Local Attributes in Community Choice

Michele Ann McMahon

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**THE ROLE OF LOCAL ATTRIBUTES
IN COMMUNITY CHOICE**

By

Michele Ann McMahon

B.A. University of Delaware, 1995

A THESIS

Submitted in Partial Fulfillment of the
Requirements for the Degree of
Master of Science
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December, 2002

Advisory Committee:

Kathleen P. Bell, Assistant Professor of Resource Economics and Policy,
Advisor

Todd M. Gabe, Assistant Professor of Resource Economics and Policy

Gary L. Hunt, Professor of Economics

Mario F. Teisl, Associate Professor of Resource Economics and Policy

THE ROLE OF LOCAL ATTRIBUTES IN COMMUNITY CHOICE

By Michele Ann McMahon

Thesis Advisor: Dr. Kathleen P. Bell

An Abstract of the Thesis Presented
in Partial Fulfillment of the Requirements for the
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Residential location choices are analyzed to determine the significance of local attributes in the moving decision. A unique data set consisting of 602 recent movers in Maine is used to perform the analysis. Additionally, municipality-level data for 531 municipalities in Maine are used in the analysis. The community-level data are fiscal, social, and environmental in nature. A conditional logit model is estimated to model the choice of community as a function of the community characteristics, and a mixed logit model is estimated to model the choice of community as a function of both community characteristics and characteristics of the household. The results suggest that quality of life attributes (specifically school quality, crime rate, parkland, lakes, and coast) play a significant role in a household's choice of community.

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Chapter 1

INTRODUCTION

An increased demand for quality of life attributes in recent decades is thought to play an increasingly significant role in residential location decisions (Deller et al 2001; Graves 1983; Johnson 1999; McGranaham 1979; Porell 1982). Quality of life attributes are not consistently defined in the literature but typically include climate, access to natural resources, and public services (Porell 1982). Changing location preferences are observed in the regional migration trends of recent decades and in the suburbanization trend referred to as urban sprawl (Graves 1999; Greenwood et al 1989). This work examines the location preferences of Maine residents. Emphasis is specifically given to the significance of quality of life attributes to residential location decisions.

Understanding the importance of quality of life attributes to residential location choice is essential for regional economic development, smart growth, and natural resource management. Whereas employment opportunities were previously considered the dominant factor influencing residential location decisions, researchers increasingly recognize the importance of quality of life attributes in household location decisions (Deller et al 2001; Graves 1983; Greenwood et al 1989; Johnson 1999; McGranaham 1999; Porell 1982). The shift in consumer preferences is largely attributed to an increased median income and an increased demand for leisure activities (Graves 1983; Greenwood et al 1989; Hayward, 2000; Linneman and Graves 1982). Areas like Maine, rich in

natural amenities, can potentially develop policies to manage their natural resources and capitalize on the increased demand for quality of life attributes in residential locations.

U.S. Census population data have been analyzed to identify population trends (U.S. Census Bureau 1990 and 2000 Census of Population and Housing). An area's population change is influenced by many factors including natural population growth, changes in technology, changes in the natural environment, changes in economic opportunities, and shifts in consumer attitudes and preferences (Johnson 1999). Historically the population of the United States has steadily increased. The U.S. population grew 13 percent from 1990 to 2000 and reached 281 million people in 2000. Though the number of total residents increased consistently, the rate of recent population growth is inconsistent across states and regions of the country.

The West experienced the greatest population growth rate (19.7 percent) between 1990 and 2000. Recent studies suggest the majority of migrants relocating to the West are drawn to this area for its social and environmental amenities (Rudzitis 1999; McGranaham 1999). A recent study reports that the majority of recent migrants to the rural West cited physical and social environment amenities as primary reasons for relocating while only 30 percent cited job-related reasons (Rudzitis 1999). A similar study compares the natural amenities and population changes of four regions in the United States: the Northeast, South, Midwest, and West. The study created an amenity scale based

on a region's climate, topographic variation, and area of surface water. The West received the highest amenity scores and the Midwest received the lowest.

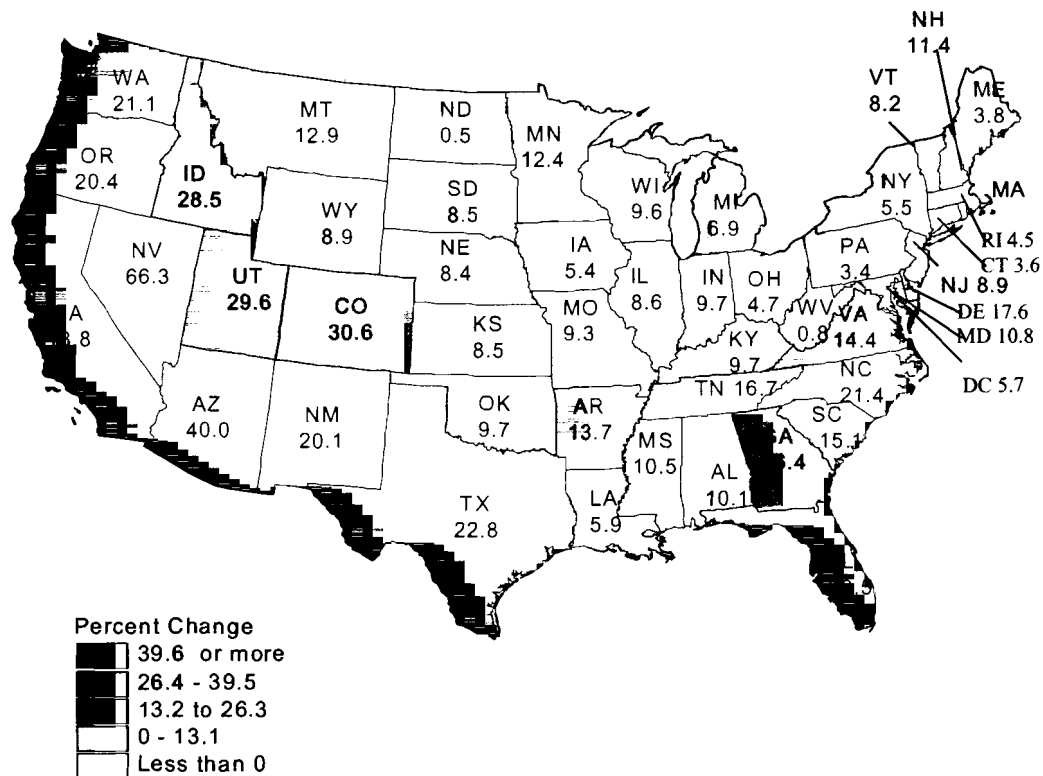
While the West experienced significant economic and population growth in the last decade, the Northeast experienced the slowest growth rate (5.5 percent) of any region in the country (U.S. Census Bureau). The Northeast experienced a loss in net migration; it was the only region in the country where more people moved from the region than to the region (Schauchter 2001). The South, which rated high on the amenities scale, experienced a population growth rate of 17.3 percent, and the Midwest, which scored lowest on the amenities scale, experienced a growth rate of 7.9 percent. McGranaham (1999) argues that variation in the 1990 to 2000 population growth rates and the migration patterns of north to south and west are explained by the variation in amenities across regions.

Researchers believe natural amenities play a more significant role in migration than they did in the past (Deller et al 2001; McGranaham 1999; Rudzitis 1999; Graves and Linneman 1982; Greenwood and Stock 1988). Previous studies have attempted to identify the relationship between employment opportunities, natural amenities, and migration but have failed to reach a consensus on the causal relationship. Greenwood and Hunt (1986) acknowledged the difficulty in determining a direct causal relationship between natural amenities and work-force migration. Because the natural amenities may be capitalized in the wage rates and rents in an area, their direct impacts are difficult to isolate or estimate. Also, lower wages may attract industry to locate in amenity-rich areas.

Therefore the natural amenities may drive the work-force migration in an indirect way (Greenwood and Hunt 1986).

Figure 1 provides a map of the nation illustrating the 1990 to 2000 population growth rates included for each state. The map clearly shows the greatest population growth occurred in the West and the South while the Northeast and the Midwest experienced much slower rates of population growth.

Figure 1. 1990 to 2000 Population Growth Rates for U.S. States



Source: U.S. Department of Commerce
(1990, 2000)

Another much-debated population trend is suburbanization. This trend is characterized by an outflow of residents from the urban centers to suburban and

rural locations. Widespread suburbanization began in the 1970s and continues today (Johnson 1999). Almost every major urban center in the nation experienced this migratory trend from 1990 to 2000 (U.S. Census Bureau). In 1999, 6.9 million people moved from the central cities while 3.7 million people moved into the central cities, resulting in a loss of 3.2 million people in urban centers (Schauchter 2001).

An important motivation behind suburbanization is the changing residential location preferences of U.S. households (Graves 2001; Greenwood et al 1989). A recent study found that many of the Maine residents that moved to suburban and rural areas cited a desire to be closer to nature as a motivation for leaving urban centers (Maine State Planning Office 1999). In contrast to the early part of the 20th century when many migrants moved to urban centers for economic, social, and cultural opportunities, many households today are leaving the metropolitan areas and relocating to suburban and rural communities rich in physical and social amenities (Greenwood et al 1989; Johnson 1999).

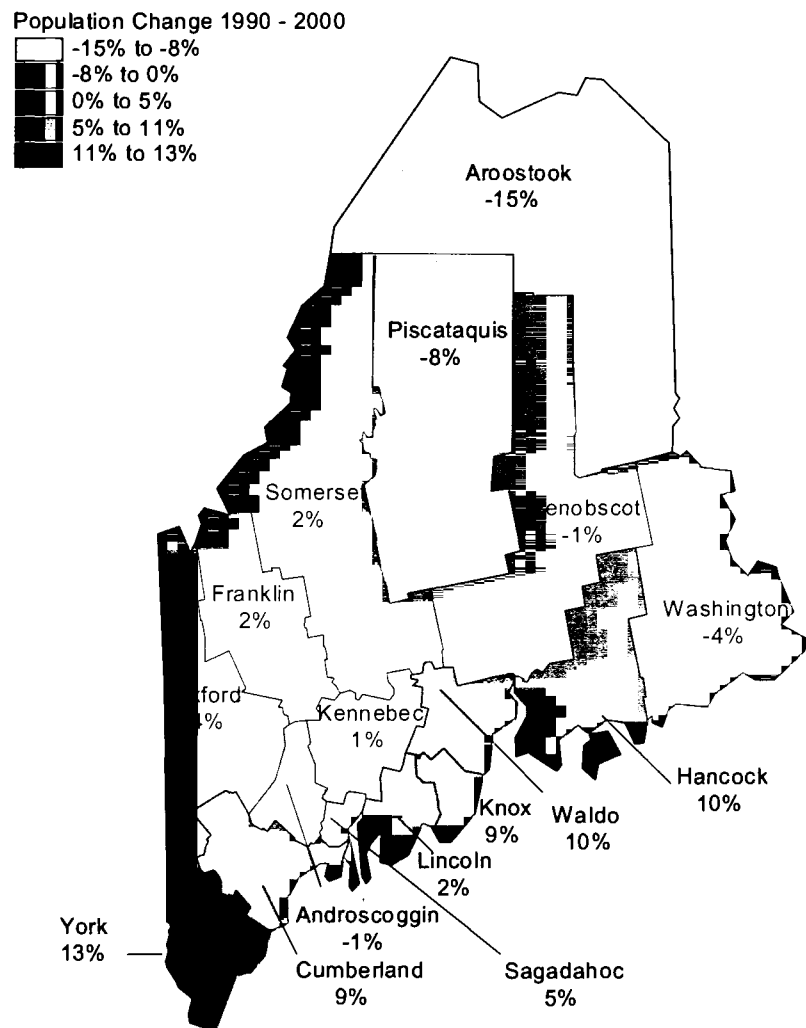
Maine, like the rest of the Northeast, experienced slow population growth (3.8 percent) compared to the national growth rate (13 percent) from 1990 to 2000. Maine experienced an increase of 52,000 residents from 1990 to 2000; its population grew from 1.22 million in 1990 to 1.27 million in 2000. The population change occurred unevenly across Maine; the majority of the counties in southern Maine experienced an increase in population and the majority of the northern counties experienced a decrease in population.

Aroostook County, the northernmost county in the state, lost 14.9 percent of its population from 1990 to 2000 while York County, the southernmost county, experienced a population growth rate of 13.5 percent (Figure 2). Almost every coastal county in Maine experienced positive growth rates except Washington County, the northernmost coastal county; it lost 3.9 percent of its population from 1990 to 2000.

The 1990 to 2000 absolute population changes presented in Figure 3 clearly show the disparity in population changes between northern and southern Maine. A bimodal population change distribution is observed in Figure 3. Aroostook County's population decreased by almost 13,000 residents while Cumberland County's population increased by 22,477 residents and York County's population increased by 22,155 residents.

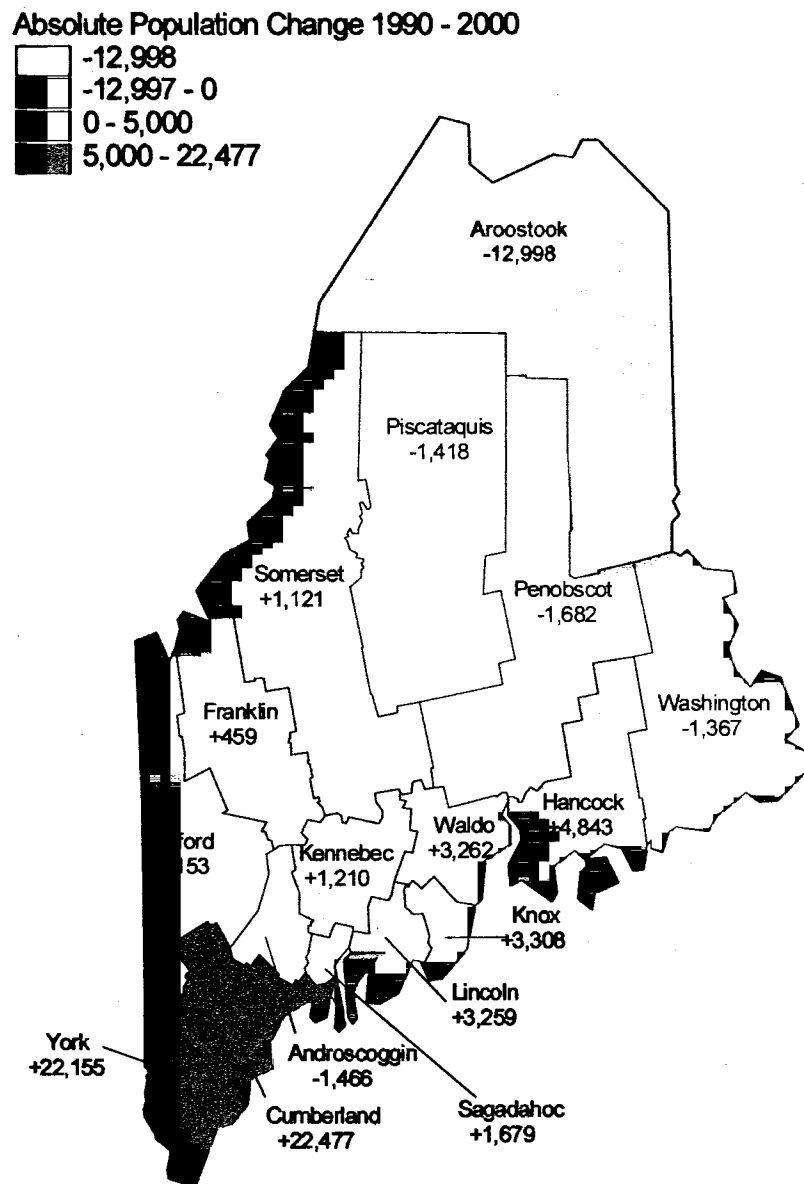
Unlike the regional migration trends occurring at the national level, the regional migration trend occurring in Maine is most likely due to the disparity in employment opportunities between the regions (Mageean et al 2000). In recent decades the counties in northern Maine lost jobs due to a decline in the logging and agriculture industries and the closing of Loring Air Force Base, while, in the same time period, the southern counties of Maine experienced economic growth (Bradbury 2001).

Figure 2. 1990 to 2000 Population Growth Rate by County



Source: U.S. Department of Commerce
U.S. Census Bureau (1990, 2000)

Figure 3. 1990 to 2000 Absolute Population Changes by County



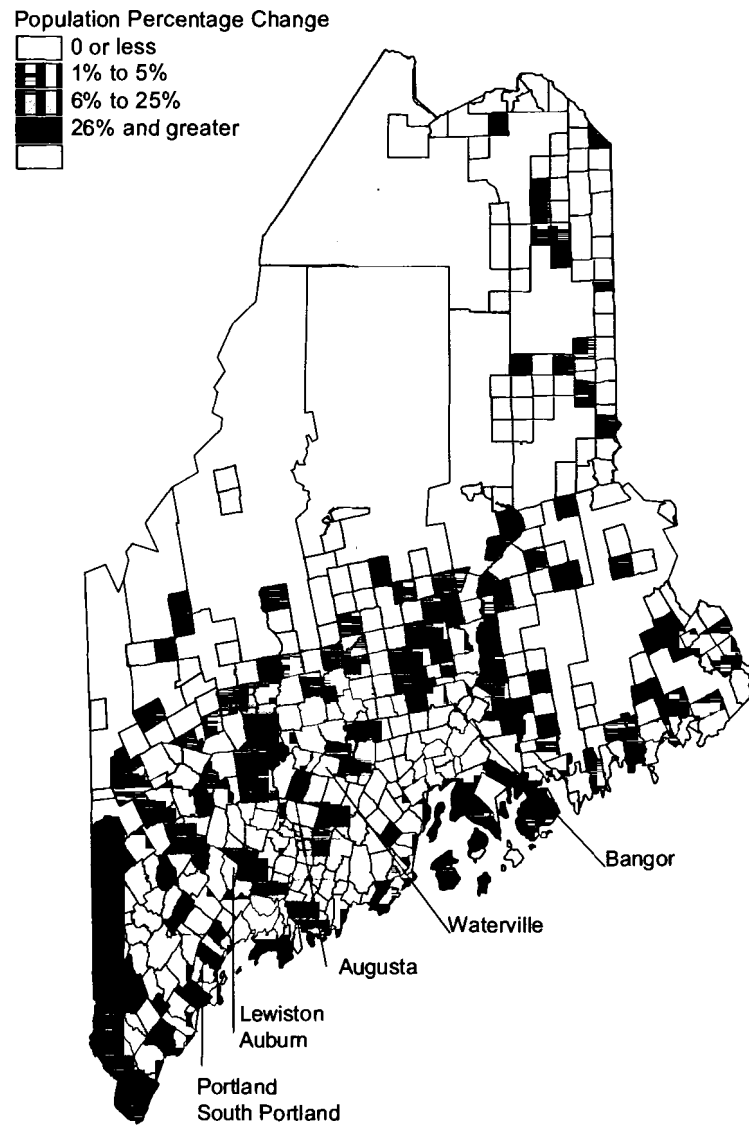
Source: U.S. Department of Commerce
U.S. Census Bureau (1990, 2000)

A suburbanization trend is also present in Maine; the state has experienced a substantial outward migration from its urban centers in recent decades (Figure 4). The Maine State Planning Office reports that for the last thirty years the fastest growing towns in the state have been the new suburbs ten to twenty-five miles outside the metropolitan areas (1997). This trend is observed in the rates of population change in Maine municipalities from 1990 to 2000 (Figure 4).

From 1960 to 2000, Falmouth and Scarborough, two suburban towns located outside of Portland, increased population by 72.5 percent and 164.4 percent, respectively (U.S. Census Bureau 2002). In the same time period, Portland experienced a loss of 11.5 percent of its population. This trend continued in the 1990 to 2000 time period but to a lesser extent. From 1990 to 2000 Scarborough and Falmouth experienced growth rates of 35.6 percent and 35.5 percent, respectively, while Portland experienced a slight increase in population with the addition of 92 new residents (a growth rate of 0.1 percent).

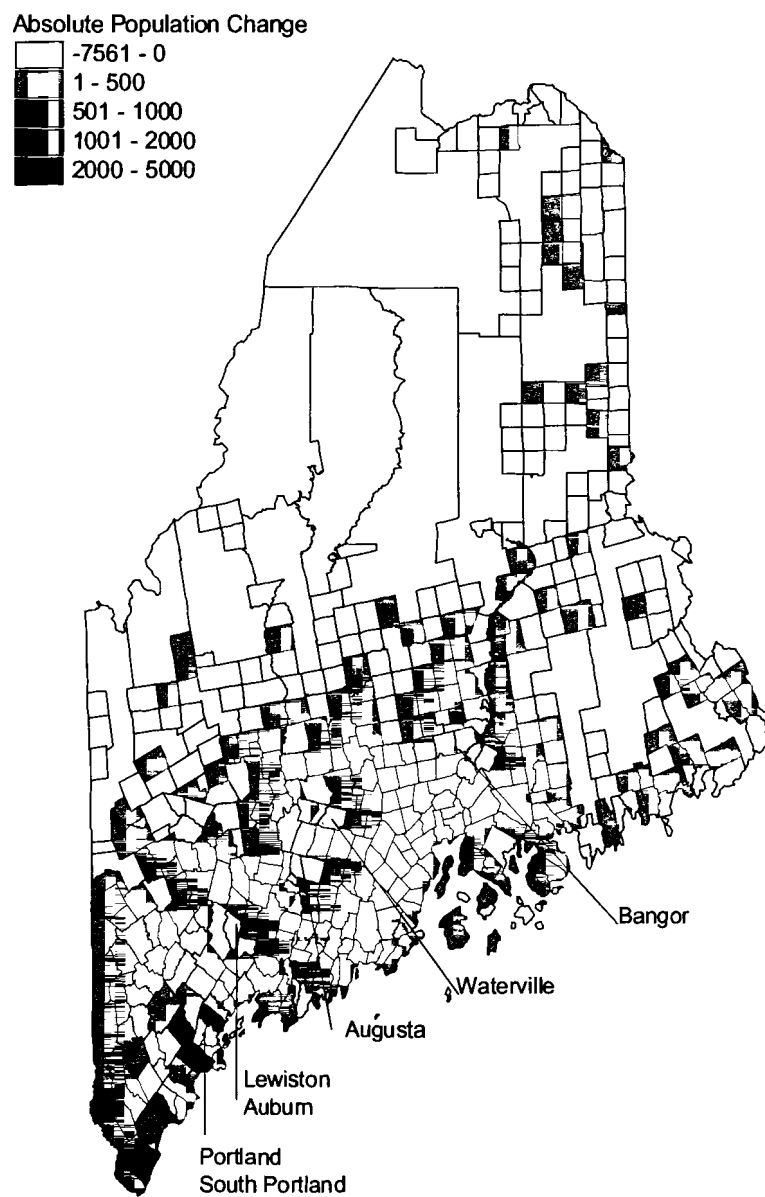
The suburbanization trend slowed in the 1990s but the larger and more established urban centers continued to experience decreases in population while the newer suburban towns experienced increases in population (Figure 5). The cities of Bangor, Lewiston, Augusta, and Auburn experienced substantial out migration and lost a combined total of 9,646 residents. Augusta, the state capital, experienced a negative population growth rate (-12.9 percent) with a loss of 2,765 residents (U.S. Census Bureau 2002). Of the twenty-five most populated urban centers in Maine, the only urban centers to gain population from 1990 to 2000 are located in the southern part of the state (Table 1).

Figure 4. 1990 to 2000 Population Growth Rates for Maine Municipalities



Source: U.S. Department of Commerce
U.S. Census Bureau (1990, 2000)

Figure 5. 1990 to 2000 Population Changes for Maine Municipalities



Source: U.S. Department of Commerce
U.S. Census Bureau (1990, 2000)

Table 1. Population Figures for the Twenty-Five Largest Towns in Maine

Town	County	1990 Population	2000 Population	1990 – 2000 Population Change	1990 – 2000 Percent Change
Portland	Cumberland	64,157	64,249	92	0.1%
Lewiston	Androscoggin	39,757	35,690	-4,067	-10.2%
Bangor	Penobscot	33,181	31,473	-1,708	-5.1%
South Portland	Cumberland	23,163	23,324	161	0.7%
Auburn	Androscoggin	24,309	23,203	-1,106	-4.5%
Brunswick	Cumberland	20,906	21,172	266	1.3%
Biddeford	York	20,710	20,942	232	1.1%
Sanford	York	20,463	20,806	343	1.7%
Augusta	Kennebec	21,325	18,560	-2,765	-12.9%
Scarborough	Cumberland	12,518	16,970	4,452	35.6%
Saco	York	15,181	16,882	1,641	10.8%
Westbrook	Cumberland	16,121	16,142	21	0.1%
Waterville	Kennebec	17,173	15,605	-1,568	-9.1%
Windham	Cumberland	13,020	14,904	1,884	14.5%
Gorham	Cumberland	11,856	14,141	2,285	19.3%
York	York	9,818	12,854	3,036	30.9%
Kennebunk	York	8,004	10,476	2,472	30.9%
Falmouth	Cumberland	7,610	10,310	2,700	35.5%
Kittery	York	9,372	9,543	171	1.8%
Presque Isle	Aroostook	10,550	9,511	-1,039	-9.8%
Wells	York	7,778	9,400	1,622	20.9%
Standish	Cumberland	7,678	9,285	1,607	20.9%
Bath	Sagadahoc	9,799	9,266	-533	-5.4%
Orono	Penobscot	10,573	9,112	-1,461	-13.8%
Topsham	Sagadahoc	8,746	9,100	354	4.0%

Bold indicates population decreases from 1990 to 2000

Source: U.S. Census Bureau (1990, 2000)

Urban sprawl has become a topic of debate in Maine due to its potentially negative effects. Sprawling land development is thought to cause a range of environmental problems (Benfield 1999; Farrow 1999; Graves 2001; Krishnamurthy 1993; Maine State Planning Office 1997). The Maine State Planning Office reports that two hundred of the 2,700 lakes in the state have been polluted from run-off associated with dispersed development; another 300 lakes are reportedly in danger (Maine State Planning Office 1997). Urban sprawl may also increase public costs by creating the need for new public goods such as schools, roadways, and fire and police stations (Maine State Planning Office 1997). Due to the concerns related to the potential costs of suburbanization, public officials are considering policies to reduce out-migration from and increase migration to the urban centers.

The results of this analysis may prove useful to that goal. Identifying the role of community-specific characteristics to a household's community choice is essential. This examination investigates the role of quality of life attributes in the location decisions of Maine movers. Further, it addresses the impact of income on changing location preferences and investigates how a household's income affects the significance of natural resource amenities in the household's community choice. Once an understanding of the preferences of Maine households is established, measures can be taken to ensure these demands are met in economically and environmentally sound ways.

Chapter 2

LITERATURE REVIEW

The literature on residential location choice is extensive in its theory, methods, and applications and a variety of economic models have been developed to explain this choice. The economic models include monocentric models of urban form (e.g., Alonso 1964; Muth 1969), economic models of individual location choices (e.g., Quigley 1985), models of regional migration (e.g., Graves 1983; Greenwood and Hunt 1986), and hedonic models of consumer housing preference (e.g., Rosen 1974; Oates 1969). The various approaches contribute to the well-developed theory of residential location choice.

The Monocentric Model of Urban Economic Theory

Urban economic models are developed to explain features of urban structures. Classic models of urban land use patterns include Alonso (1964) and Muth (1969). These models specifically address the centralization of businesses and the diminishing land prices and rents that occur as distance from the central business district increases. The monocentric city model is based on the idea that transportation is costly and households make tradeoffs between transportation costs and land rents in their location choices. This model implies a negative relationship between land price (housing prices) and distance (time) to the urban center (Goodman 1989).

The monocentric city model is able to characterize housing in simple terms: land and accessibility to the urban center. However, this may be oversimplifying the housing market. The model does not typically consider neighborhood attributes and other features that vary over space which are important to a household's location decision.

Hedonic Models

Hedonic pricing models can be used to describe household residential location preferences. These models treat goods as bundles of attributes and thus provide a convenient way to value community attributes. Non-market goods can be implicitly valued by comparing prices of houses with differing levels of the non-market good. Rosen (1974) provides the classic theoretical framework for the hedonic pricing model and shows the demand for various community attributes can be estimated using this method.

Hedonic models have been used in a variety of applications to implicitly value various non-market goods including air quality (e.g., Palmquist 1991), access to beaches (e.g., Taylor 2002), and quality of life attributes (e.g., Bloomquist et al 1988). These studies provide extensive evidence that environmental amenities (e.g., air quality, water quality, open space) are important in the residential location choice (Blomquist 1988; Palmquist 1999; Taylor and Smith 2000).

The demand for community attributes is typically modeled after the Tiebout theory of community choice (Tiebout 1956). The Tiebout theory

contends that households possess different preferences for local attributes and public goods are an important component of preferences when choosing a community. Tiebout suggests that households consider their income and the attributes of the community and select the community that offers the most preferred bundle of public goods (Tiebout 1956). This framework emphasizes the role of location-specific amenities in the moving decision.

Oates (1969) provides empirical verification to support the Tiebout hypothesis. He employs a hedonic pricing model to estimate the impact of local goods on residential location choices of New Jersey residents. Specifically Oates investigates the effect of local property taxes and local public expenditures on local property values. The findings of this study indicate that local public expenditures have a significant and positive impact on local property values. These results support the Tiebout theory of residential location choice and imply that households are willing to pay more to live in a community with a higher level of public services. Oates' study provides verification that community-specific amenities are significant factors in a household's residential location decision.

The results indicate environmental amenities increase utility and play a significant role in residential location. Hedonic models are useful in valuing non-market goods such as community-specific attributes, but hedonic models do not explicitly model a household's residential location choice.

Discrete Choice Models

Currently the most common modeling framework of residential location choice is a discrete choice framework introduced by McFadden (1978). This framework is based on the classic economic theory of utility maximization and assumes a household will choose the residential location that provides the maximum level of utility. In McFadden's modeling framework, the residential location choice is assumed to be not only a function of the characteristics of the residential location but also a function of characteristics of the household. McFadden (1978) focused on the role of housing characteristics (as opposed to community-specific characteristics) and individual characteristics in the residential location choice.

Quigley (1985) follows the framework established by McFadden (1978) and models the location choice of Pittsburgh movers by employing a three-stage nested logit model. The first stage represents a choice of the characteristics of the dwelling, the second stage represents a choice of town or municipality, and the third stage represents the choice of local public goods and services.

Quigley finds an inverse relationship between local public expenditures and residential location choice. Quigley's results are inconsistent with the results of Oates; the discrepancy may be due to the differences in modeling techniques (hedonic as opposed to discrete choice), differences in the levels and quality of data, and differences in the study areas.

McFadden (1978) and Quigley (1985) jointly establish the traditional theoretical framework of economic analyses that model location decisions as a

function of individual characteristics and community characteristics. These studies have found age, income, marital status, household size, and profession to be significant individual characteristics in explaining residential location decisions and have found public expenditure levels, quality of schools, commercial activity, distance from a metropolitan area, crime rate, and environmental amenities to be significant community characteristics in the moving decision.

Nechyba and Strauss (1998) employ a discrete-choice modeling framework to estimate the influence of local public services on residential community choice in Camden County, New Jersey. Micro-level data of New Jersey homeowners is employed in conjunction with community specific information to conduct the analysis. The results suggest that commercial activity, distance from a metropolitan area, public school expenditures, and community entry prices have significant influences on the residential location decision, while crime rate has a significant and negative impact on the choice of community.

Dahlberg and Frederiksson (2000) employ micro-level data to estimate the influence of public services on community choice in Sweden. The study differentiates between short distance movers (defined as individuals moving within a labor market) and long distance movers (those entering into new labor forces). Their results suggest a significant relationship between public services (proxied by public expenditures) and residential location choice. The authors find that public services are less important to movers entering from other labor

markets. They hypothesize that long-distance movers may not have the option to be as selective as short-distance movers in their residential community choice.

Most recently Colombino and Locatelli (2001) utilize the discrete choice approach to estimate the influence of local public services on the residential location choices of Italian households. The choice is assumed to be a function of individual characteristics, income, dwelling quality, local taxes, and expenditures on public goods. Micro-level data and location-specific characteristics are utilized much in the same fashion as Nechyba and Strauss (1998). The results suggest that dwelling quality, location, and local public services have a significant influence on the community choices. The authors contend that local public services play a significant role in a household's community choice.

An interesting finding of Colombino and Locatelli (2001) is that households prefer to live in a large town to a small town and prefer to live downtown as opposed to in the suburbs. These results conflict the current moving trends in Maine and in the United States. The difference in consumer preference and residential location choices may be due to cultural differences or differing levels of public services in urban and suburban areas in the United States and Italy.

Models of Migration

Similar to the economic models that represent the location choices of individuals, a literature exists that explicitly represents the migration decisions of

individuals. These models focus on the impact of varying levels of employment opportunities and regional amenities on migration decisions.

The classic migration theory states that employment opportunities are the primary determinants of migration (Goodman 1989). Greenwood and Hunt (1986) provide verification to support this migration theory. The authors found that the importance of economic factors overshadows the importance of local amenities in a household's location decision (Greenwood and Hunt 1986). The authors recognize the interdependence between employment, amenities, and migration and acknowledge the difficulty in determining a causal relationship (Greenwood and Hunt 1986). Many other researchers have recognized the difficulty in establishing a direct causal relationship due to the interdependence of the migration variables (e.g., Mueser and Graves 1993; Linneman and Graves 1983; Greenwood et al 1989).

Though the direct effects are difficult to estimate, researchers have found that amenities play an increasingly significant role in the regional migration decision (e.g., Graves 1982; Greenwood et al 1989; Knapp and Graves 1989; Porell 1982). As mentioned in Chapter 1, increased median incomes are thought to contribute to an increased demand for natural amenities and leisure activities (Graves 1982; Greenwood et al 1989; Knapp and Graves 1989; Porell 1982).

The investigation into natural resource amenities and quality of life attributes has sparked a line of research concerned with defining quality of life variables and identifying their role in migration decisions. One study creates an amenity scale based on climate and natural resource amenities and quantifies a

rating for comparison between regions (McGranaham 1999). Another study stratifies quality of life variables into six categories (climate, natural recreational amenities, social amenities, crime, air pollution, and health) to be used for analysis (Porell 1982). These studies find the role of quality of life attributes to be increasingly significant in location decisions (Porell 1982; McGranaham 1999).

Louis Ploch, in conjunction with the Maine Agricultural Experiment Station, conducted a nine-year study of in-migration to Maine from 1975 to 1983. Ploch (1988) reported that individuals migrating to Maine were young adults with high levels of education and professional experience; he further noted that a substantial percentage of immigrants were relocating to rural communities in the state. Ploch contended that the immigrants were moving to Maine for its rural charm and quality of life attributes (Ploch 1988).

Graves (2001) and Nelson and Sanchez (1997) provide economic analyses of the suburbanization trend in the United States. Graves examines suburbanization in a theoretical welfare economics framework while Nelson and Sanchez perform cluster analysis techniques to analyze Annual Housing Survey data. Both studies contend that suburban migration is the result of a failure to provide affordable public goods (e.g., environmental amenities, safety, high quality schools, etc.) in urban centers. It follows that households substitute non-urban locations for urban centers to obtain these public goods at affordable prices.

Modeling Community Choice in Maine

A variety of theoretical and empirical economic models of residential location choice have been developed, with differences among models arising frequently from their intended purpose or empirical application. Common to all of these approaches is an appreciation of the tradeoffs households make when deciding where to locate. Whether the model is explicitly representing a location choice (e.g., economic models of the location choices of individuals (Quigley 1985)) and the migration decisions of individuals (Graves 1983; Greenwood and Hunt, 1986) or implicitly characterizing the preferences of households for location attributes (e.g., hedonic models of residential property values (Boyle et al 1999; Oates 1969) and models of land conversion to residential land uses (Bockstael 1996; Irwin and Bell 2002), the relative influence of myriad factors is essential to the economic behavior underlying the location decision. The various studies provide a basic understanding of the significant influences in residential location decisions and provide a foundation on which to perform this analysis.

This thesis builds on the conceptual framework established by McFadden (1978) and models residential location choice using micro-level household data and community-specific characteristics. The analysis examines the relative significance of community-specific attributes to the moving decisions of Maine movers. The analysis builds on the findings of hedonic studies (e.g., Boyle et al 1999) and land-use change studies (e.g., Bockstael 1996) by emphasizing the role of community-specific environmental amenities in the location decision. This examination also investigates the findings of various migration studies (e.g.,

Graves 1982; Porell 1982; Ploch 1988) by investigating the role of quality of life attributes in the location decisions of Maine movers. Finally, this thesis considers various studies that address the impact of income on changing location preferences (e.g., Graves 1982; Greenwood et al 1989; Knapp and Graves 1989; Porell 1982) and investigates how a household's income affects the significance of natural resource amenities in the household's residential location choice.

Chapter 3

THEORETICAL MODEL

This chapter describes the theoretical model of household location decisions that establishes the framework for the empirical analysis of this thesis. As noted in Chapter 2, a variety of theoretical and empirical economic models of residential location choice have been developed. This analysis builds on the findings of various theoretical models of residential location choice in order to identify the influence of both community-specific characteristics and household characteristics on the location decisions of Maine movers.

This thesis assumes that a household considers a community's price, location, quality of life attributes, and natural resource amenities in the location decision and further assumes that a household's income affects the way certain attributes enter into the household's utility function.

Household migration studies report economic opportunities significantly influence a household's migration decision (e.g., Greenwood and Hunt 1986). It is then expected that a community's employment opportunities significantly and positively influence a household's residential location decision. Further, urban economic literature recognizes the tradeoffs made by households in the residential location choice (Goodman 1989). The monocentric model of urban economic theory posits that a community's attractiveness decreases with its distance from a commercial business district (Goodman 1989). Based on this theory households

are assumed to locate in communities (or close to communities) rich in employment opportunities.

As noted in Chapter 1, quality of life attributes are thought to play an increasingly significant role in residential location choices (Graves 1982; Greenwood et al 1989; Knapp and Graves 1989; Porell 1982). It would follow that quality of life attributes such as crime rate, school quality, and level of public services should significantly influence a household's decision to locate in a given community.

Natural resource amenities have also become increasingly important in household moving decisions (Graves 1983; McGranahan 1999). Location-specific attributes such as climate, mountains, seacoasts, and public parks (to name a few) increase the attractiveness of a community and positively influence a household's location decision. This analysis explores the impact of lakes, parks, and a seacoast on a household's choice of community.

Household attributes are also assumed to influence the choice of community. Characteristics such as age, income, and education level may influence a household's utility function and affect the importance or significance of community-specific attributes. Graves (1979) explored this extensively in his research on life-cycle migration. In this analysis, the impact of a household's income is explored. It will be determined if an increased income positively affects the significance of natural resource amenities in the location decisions.

Because location decisions involve the selection of a single, discrete alternative from a set of numerous alternatives, the random utility modeling

framework is especially suited to represent the economic behavior of location decisions. This is elegantly demonstrated in McFadden (1978) which presents a rigorous discussion of the application of the random utility modeling framework to choices of residential location. Other relevant theoretical developments are summarized in Greenwood (1985) and in Muth and Goodman (1989).

Consider a household who is faced with making a location decision. The household will ultimately select a single community j from a set of communities. Assuming the household is a utility-maximizing decision-maker, the selected community is expected to correspond to the community offering the highest level of utility to the household. To formally explore this correspondence, it is necessary to describe the factors that influence the utility derived by location or community choice.

Let household i receive utility U_{ij} from selecting to locate in community j . The utility derived by a household from locating in a community is expected to be a function of the characteristics of the household as well as the characteristics of the community. Ultimately, the selection of community j depends on whether or not this alternative affords the highest level of utility to household i . Expressing utility as a function of a deterministic portion, V , and a stochastic portion, ϵ , the utility gained by household i from choosing community j is denoted:

$$(1) \quad U_{ij} = V_{ij} + \epsilon_{ij}$$

where V_{ij} is the observed indirect utility associated with this choice and ε_{ij} accounts for the error associated with our lack of knowledge as researchers. In turn, the selection of community j from the set of communities ($c \in C$) by household i is expected if and only if:

$$(2) \quad V_{ij} + \varepsilon_{ij} > V_{ic} + \varepsilon_{ic}, \quad \forall c \neq j; j, c \in C.$$

Using the expression above, the probability of household i selecting community j may be written as follows:

$$(3) \quad P_{ij} = P(\varepsilon_{ij} - \varepsilon_{ic} > V_{ic} - V_{ij}), \quad \forall c \neq j; j, c \in C.$$

The probabilistic expression shown above serves as the basis of the random utility modeling framework employed in this thesis. To implement this model, assumptions regarding the functional form of V and the distribution of ε are necessary. Begin with the assumption that the indirect utility function has a linear-in-parameters functional form. This enables the utility of household i to be written easily as a function of household attributes, W , and community attributes,

X. The observed portion of the indirect utility of the i th household can be represented as

$$(4) \quad V_{ij} = \beta X_{ij} + \alpha W_i,$$

where X_{ij} denotes a vector of characteristics of community j as perceived by household i , W_i denotes a vector of household i 's characteristics, and β and α are vectors of parameters to be estimated. The vector of community attributes, X , may contain variables describing a community's price, location, quality of life attributes, and natural resource amenities. The vector of household characteristics, W , may contain a household's income, age, and number of children. Further, if we assume that the stochastic portion of utility is comprised of errors that are independently and identically distributed type 1 extreme value, the probability that household i chooses community j from the set of C communities can be rewritten as follows:

$$(5) \quad P_{ij} = \frac{\exp(\beta X_{ij} + \alpha W_i)}{\sum_{c=1}^C \exp(\beta X_{ic} + \alpha W_i)}$$

This choice probability corresponds with a mixed logit framework where characteristics of the individuals making the decisions and the alternatives from

which they are choosing are both relevant. However if modeled as shown in (5), the terms W_i do not vary across households and fall out of the probability. Accordingly, the model must be modified in order to allow household specific effects. Fixed effects can be added if the choice set (C) is of manageable size. Interaction terms between households and individuals may also be introduced to allow the household characteristics to vary across the choices. The probability that household i chooses community j then becomes:

$$(6) \quad P_{ij} = \frac{\exp(\beta X_{ij} + \alpha Z_{ij})}{\sum_{c=1}^C \exp(\beta X_{ic} + \alpha Z_{ij})}$$

where $Z_{ij} = W_i * X_{ij}$

The model can be simplified if only community characteristics are considered. The probability that household i chooses community j is then written as a conditional logit model:

$$(7) \quad P_{ij} = \frac{\exp(\beta X_{ij})}{\sum_{c=1}^C \exp(\beta X_{ic})}$$

The conditional logit model and the mixed logit model present reasonable and reliable approaches to describing discrete choices. OLS is an impractical method to describe such choices for several reasons. First, a discrete choice model estimates the probability of observing a specific outcome or choice. There is nothing in the OLS linear probability model to restrict the value of P_{ij} to the interval (0,1) and therefore the OLS model may produce impractical probabilities. The second impracticality of the OLS model for discrete choice estimation is that OLS may produce negative variances (Greene 1993).

Chapter 4

DATA RESOURCES

Primary and secondary data sources are utilized here in the analysis of the residential location decisions of Maine movers. The primary source is survey data of recent movers in Maine. Secondary data include fiscal, social, and environmental characteristics of municipalities in the state of Maine. This combination of data resources provides an interesting framework in which to study residential location choices.

The Survey of Recent Maine Movers

In 1998, the Maine State Planning Office conducted a telephone survey of recent movers in Maine. The final sample included 602 recent movers and was created from two sample sources provided by Survey Sampling, Inc. – a list of recent movers and a random digital dial (RDD) sample. A recent mover for the purpose of this study was defined as a household who moved in the last five years. Eighty-five percent of those surveyed had moved in the last two years (Maine State Planning Office 1999).

The telephone survey collected detailed information about the households' moves and the households' socio-economic characteristics. The movers were asked questions about their previous location, the new municipality chosen, the value of the old home, the value of the newly purchased home, and their reasons

for moving. Demographic characteristics collected include age, number of children, education, and income.

The Movers

The households in the survey sample are not expected to perfectly represent perfectly the population of Maine households. The sample of movers was randomly drawn and may be expected to represent the characteristics of recent Maine *movers*. To investigate the extent to which the sample may represent recent movers statewide, data on recent Maine movers were downloaded (1990 IPUMS (Integrated Public Use Microdata Series)) from the Minnesota Population Center website (www.ipums.umn.edu). A sample of households that had moved in the last two years was selected – this provided a dataset of over 6,000 households. The data were then converted into categories to match the survey sample data categories. The sample of recent movers was then compared to the PUMS movers. The movers in the survey sample are, on average, of similar age, have higher incomes, and have attained higher levels of education than the movers in the PUMS sample and the general population of Maine (Table 3). The IPUMS data may not compare well with the sample of movers due to differences in the dates of data collection; the movers in the survey sample moved between 1996 and 1998 and the movers in the PUMS data moved between 1989 and 2000.

Table 2. Characteristics of Maine Residents, PUMS Movers, and Survey Sample Movers

Frequency Distributions	Maine Population*	PUMS Movers**	Movers In Sample***
Age:	Percent	Percent	Percent
Less than 25	9%	7%	5%
25 - 34	15%	16%	30%
35 - 44	22%	23%	32%
45 - 54	22%	20%	16%
55 - 64	14%	13%	10%
65 - 74	11%	10%	6%
75 and older	8%	9%	1%
Income:			
Less than \$15,000	20%	16%	5%
\$15 - \$24,999	16%	14%	15%
\$25 - \$34,999	16%	14%	14%
\$35 - \$49,999	19%	19%	25%
\$50 - \$99,999	25%	30%	35%
Greater than \$100,000	5%	8%	7%
Education:			
Grade school	6%	5%	1%
Some high school	11%	9%	2%
High school graduate	40%	36%	24%
Some college	18%	20%	15%
2-year college graduate	7%	8%	11%
4-year college graduate	12%	15%	30%
Graduate Degree	6%	8%	16%

* Source: U.S. Census of Population and Housing Summary File 3

** Source: Integrated Public Use Microdata Series: Version 2.0

*** Source: 1998 Maine State Planning Office Survey sample data

Percentages may not sum to zero due to rounding

Also of interest is the comparison of two subsets of movers in the survey sample, in-state movers and those relocating from another state. A noticeable difference is observed in both the characteristics and the community choices of in- and out-of-state movers in the sample. The sample contains 480 in-state movers and 122 movers who relocated from another state.

Out-of-state movers in the sample are, on average, older, earn higher incomes, have attained a higher level of education, have fewer children and are more likely to be married than the Maine movers (Table 4). The most noticeable differences are reflected in the incomes and education levels of the two groups of movers. For example, 61 percent of out-of-state movers earned an income of \$50,000 or greater while only 47 percent of in-state movers earned \$50,000 or greater. Also, 66 percent of out-of-state movers attained a college or graduate degree while 41 percent of in-state movers attained the same level of education.

The characteristics of the households moving to Maine from outside the state are consistent with the findings of Louis Ploch (1988). Ploch (1988) noticed significant demographic differences between the in-migrants and the residents of Maine. The in-migrants were more highly educated and reported higher income levels. Ploch also noted a substantial percentage of in-migrants were relocating to rural communities in the state, and he contended that the in-migrants were moving to Maine for its rural charm and quality of life attributes.

Table 3. Characteristics of In-State and Out-of-State Respondents*

Frequency Distributions	All Movers in Sample	In-State Movers	Out-of-state Movers
Age:	Percent	Percent	Percent
Less than 25	5%	6%	1%
25 - 34	30%	31%	25%
35 - 44	32%	32%	33%
45 - 54	17%	16%	20%
55 - 64	10%	9%	13%
65 - 74	6%	5%	7%
75 and older	1%	1%	1%
Income:			
Less than \$15,000	5%	5%	3%
\$15 - \$24,999	15%	15%	11%
\$25 - \$34,999	14%	15%	8%
\$35 - \$49,999	25%	27%	16%
\$50 - \$64,999	18%	16%	24%
\$65 - \$79,999	12%	12%	12%
\$80 - \$99,999	6%	4%	13%
Greater than \$100,000	7%	6%	11%
Education:			
Grade school	1%	0%	2%
Some high school	2%	2%	2%
High school graduate	24%	29%	13%
Some college	15%	17%	8%
Two-year college graduate	11%	11%	9%
Four-year college graduate	30%	30%	30%
Graduate Degree	16%	11%	36%
Single Households:			
Percent Single	18%	14%	7%
Number of Children:			
Zero	54%	54%	55%
One	16%	16%	18%
Two	20%	20%	19%
Three	7%	6%	7%
Four	2%	3%	1%
Five	1%	1%	0%
Number of Observations	602	490	122

* An in-state respondent is one who moved within the state of Maine and an out-of-state respondent is one who moved to Maine from another state

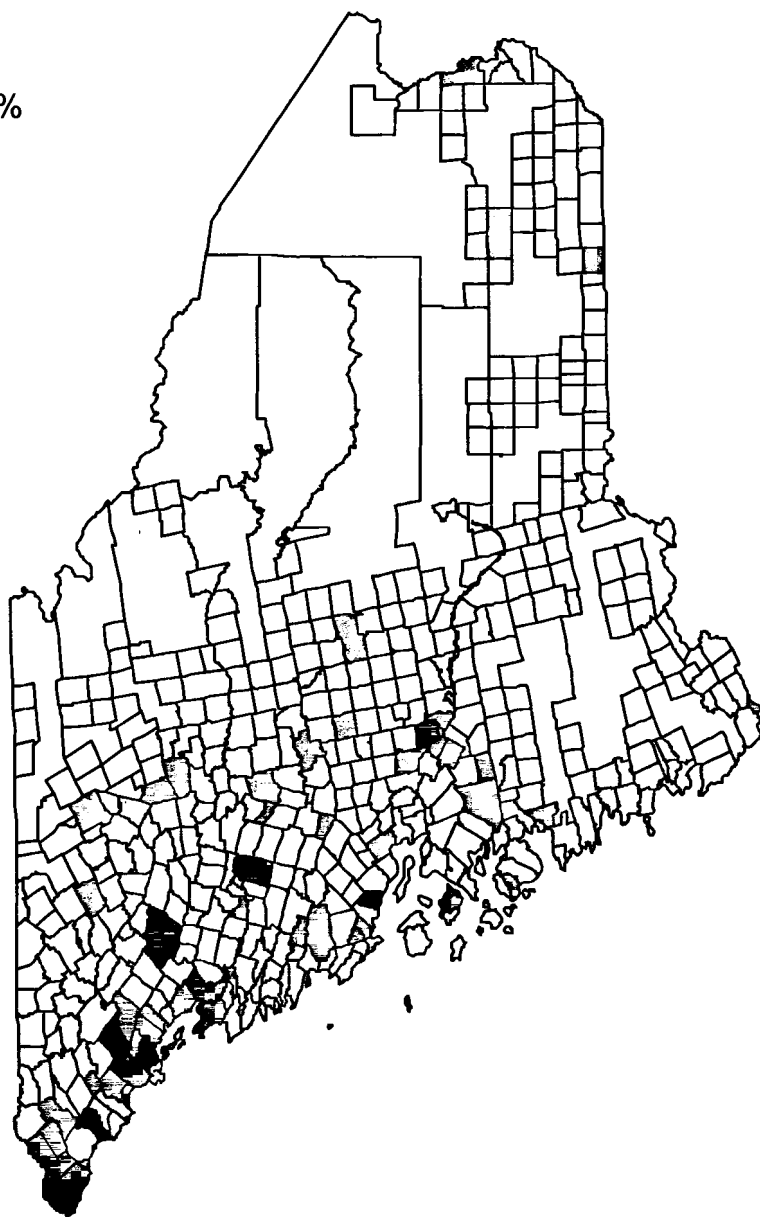
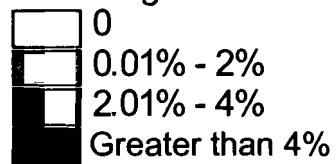
Community choices differ across the in- and out-of-state movers (Figure 6). Within the sample, the towns of Eliot, Kennebunk, and Portland received the highest concentration of out-of-state movers. Generally the out-of-state movers tended to migrate either to the southern coastal region of Maine or to rural communities throughout the state.

Figure 7 exhibits the frequencies of chosen communities by in-state movers. A comparison of Figure 6 to Figure 7 reveals differences in moving patterns. Though both groups have a high concentration of movers locating in southern Maine, the community choices appear to differ between the groups. A high percentage of in-state movers moved to the urban centers in Maine. Portland was the most commonly selected location for in-state movers (40 households) followed by Bangor and Lewiston.

Due to the apparent differences in household characteristics and community choices between in- and out-of-state movers, hypothesis tests will be conducted to determine if the moving decisions of these two groups are statistically different. This thesis will test the hypothesis put forth by Louis Ploch (1988) that many out-of-state movers choose to locate in Maine for its rural lifestyle and environmental amenities.

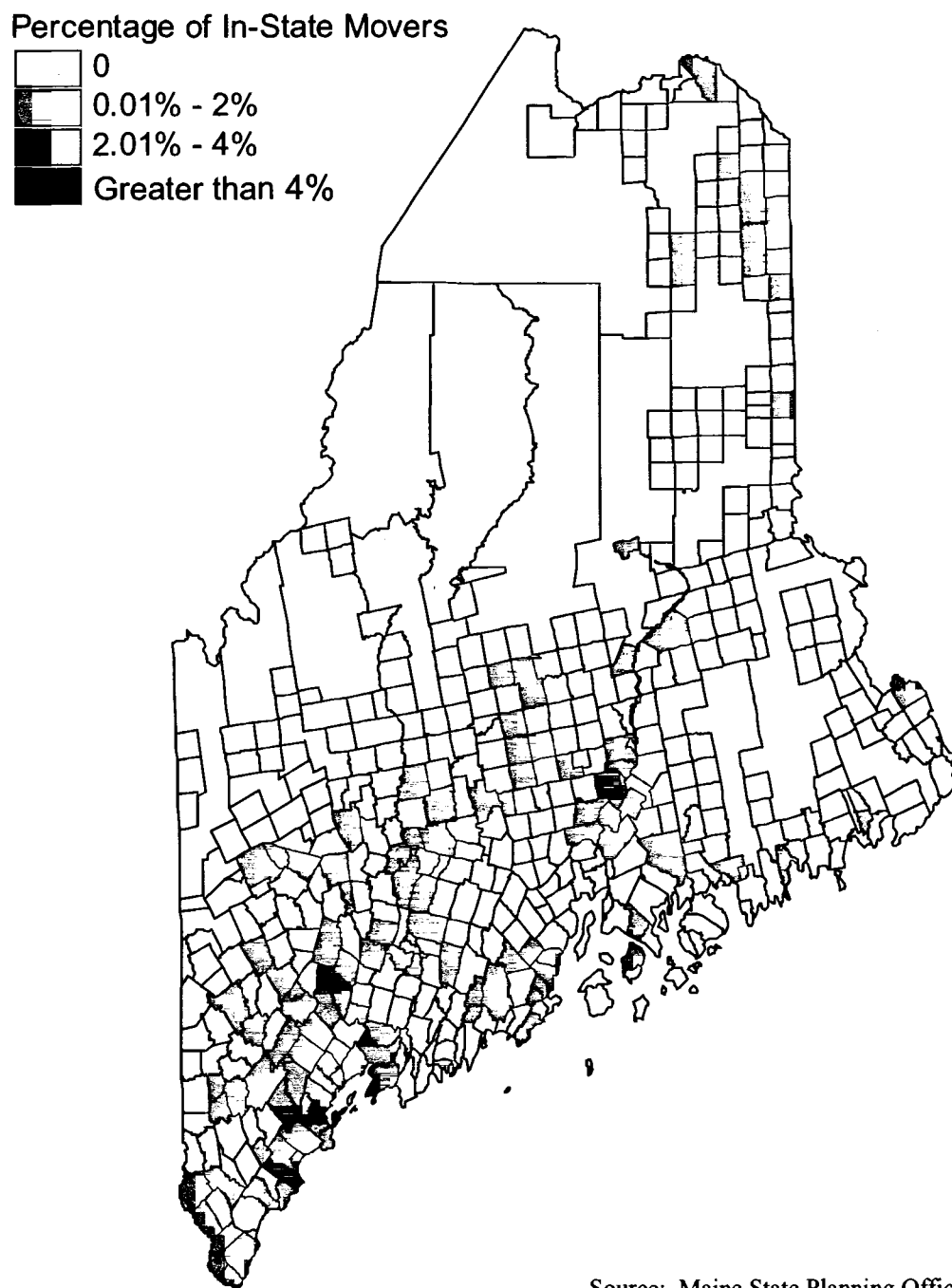
Figure 6. Community Choices of Out-of-State Movers in Survey Sample

Percentage of Out-of-State Movers



Source: Maine State Planning Office
1998 Survey Sample Data

Figure 7. Community Choices of In-State Movers in Survey Sample



Source: Maine State Planning Office
1998 Survey Sample Data

Secondary Data

Federal, state, and local agencies were contacted in the secondary data collection process. Employment, housing, urbanization, quality of life, and natural resource data were collected for municipalities in Maine. In what follows, various sources of secondary data are discussed. The community variable names, definitions, data sources, and descriptive statistics are presented in Table 5.

Economic Variables

Historically economists have assumed that the primary determinant of location choice is the economic opportunities. Data on total number of jobs in 1990 were collected for the municipalities in the analysis. The data were obtained from the Maine State Planning Office website (<http://www.state.me.us/spo/economic/MCD/newlist.htm>); the jobs data are part of the State Planning Office's minor civil divisions database. The total number of jobs was divided by the total number of housing units in the municipality. The ratio of jobs to houses reflects the extent to which a community is a bedroom community, mixed residential and commercial, or a commercial area. The number of housing units data were obtained from the US Census Bureau's Census of Population and Housing Summary File 3.

Property tax rate data were collected from the Maine Revenue Services. The tax rate used in this analysis is the 1998 tax rate. Per capita spending is calculated by dividing the community's 1998 total public expenditures by the 2000 population of the community. The data were collected from the

Table 4. Variable Names, Definitions, Data Sources, Means and Standard Deviations

Name	Definition	Data Source	Mean and Std. Dev.
Jobs	Total number of jobs divided by total housing units	Maine State Planning Office and U.S. Census Bureau	0.51 (0.53)
Tax	Property tax rate	Maine Revenue Services	1.65 (0.47)
Spending	Per capita public expenditures	Maine Revenue Services	1006.59 (642.00)
Price	Median house value in thousands of dollars	U.S. Census Bureau	105.229 (36.91)
Density	Population divided by the total land area of a municipality	U.S. Census Bureau, Maine Office of GIS	0.07 (0.14)
CBD	Number of kilometers from community to the nearest central business district	Maine Office of GIS	41.24 (27.06)
Road	Number of kilometers from community to the nearest major roadway	Maine Office of GIS	26.01 (27.35)
School	The inverse of the high school ranking based on average REA scores	Maine Dept. of Education	0.03 (0.06)
University	Dummy variable that equals 1 if a university is in the municipality; 0 otherwise	State of Maine website www.Maine.gov	0.05 (0.22)
Crime	Crime rates (total number of crimes per 1,000 people)	Maine Department of Public Safety	26.49 (8.66)
Parks	Percentage of total land area in parkland	Maine Office of GIS	0.04 (0.09)
Lakes	Square kilometers of total surface area of lakes in the municipality	Maine Bureau of Land and Water Quality	15.51 (36.04)
Coast	Dummy variable that equals 1 for a coastal community; 0 otherwise	Maine Office of GIS	0.42 (0.49)

the Maine Revenue Service and the U.S. Census Bureau's 1990 Census of Population and Housing Summary File 3, respectfully.

Price denotes the median housing value in a community; these data were collected from the U.S. Census Bureau's 1990 Population and Housing Summary File 3. Economic theory suggests that housing is a normal good and the price of housing should have an inverse relationship with its demand. Therefore, the higher the housing costs in a community, *ceteris paribus*, the less likely a household is to choose that community for a residential location.

Density and Distance Variables

Three variables will be used to represent the urbanization and location of a community, population density, distance to a central business district, and distance to a major roadway. Population density is calculated by dividing the total land area of a municipality by the 1990 population. The land areas of the municipalities were calculated using a Geographic Information System (GIS) and are reported in square meters. Town boundaries were obtained from the U.S. Department of Commerce.

Two measures of distance were calculated for the analysis. The distance variables are motivated by urban economic theory stating that locations become less desirable the farther they are from an urban center (Goodman, 1989). A GIS was used to calculate the distance from the various communities in the sample to

the nearest central business district (CBD)¹. The second distance variable is the distance from a community to the nearest major roadway (i.e., I-95). This distance was also calculated using a GIS. Both of these distances are measured in kilometers.

Quality of Life Variables

The quality of life variables include high school quality, the presence of a university, and the community's crime rate. The quality of life variables are motivated by numerous studies of migration and economic development (Deller et al 2001; Greenwood and Hunt 1986; Porrell 1982). Typically the quality of life variables include public services, climate and natural resource amenities. Climate is ignored here due to a lack of variation and the natural resource amenities are treated as a separate subgroup in this analysis.

School rank is used to represent the school quality of a given community. The ranking is based on the three-year averages (1994 – 1996) of the 11th grade Maine Educational Assessment Tests. The school ranking was obtained from the Maine Department of Education and is available to the public. The communities without a ranked school were assigned the average rank of the schools in the given region.

A dummy variable is used to denote the presence of a university in a municipality. A list of Maine universities and colleges and their addresses was

¹ Each community was assigned a CBD unique to its region. The CBD's were designated as: Region 1: Portland or Lewiston/Auburn, Region 2: Augusta or Farmington, Region 3: Waterville, Region 4: Rockland, Belfast or Ellsworth, Region 5 Presque Isle or Bangor

obtained from the state of Maine's official website
(<http://www.maine.gov/portal/education/colleges.html>).

Crime rates for 1998 are reported for 109 municipalities in the state. The crime rates measure the total number of crimes per 1,000 people. The data were collected from the Maine Department of Public Safety. If the Department of Public Safety did not report a crime rate for a municipality in 1998, the crime rate was entered as the average of the crime rates in the given region.

Natural Resource Variables

Area of parkland per municipality was calculated from a GIS coverage obtained from the Maine Office of GIS. The area considered parkland in this analysis is land in state, federal, and non-profit conservation ownership. The data for conservation land are used due to the difficulty of obtaining data for local public parks at a municipality level. The total parkland is divided by the total area of the municipality to produce the percentage of parkland in a given municipality. Both total parkland and total town area are measured in square meters.

Total lake surface area per municipality data were collected from the Maine DEP's Bureau of Land and Water Quality. A database of roughly 5,000 Maine lakes was provided by the Bureau and included water clarity, surface area, and associated municipality for each lake. The surface areas of all lakes associated with each municipality were added together to produce the total lake surface area per municipality. The total surface area is measured in square meters.

Finally, a dummy variable is included to denote coastal communities; 1 denotes the community is within 12 kilometers (approximately 10 miles) of the coast, 0 otherwise.

Chapter 5

THE EMPIRICAL MODEL

The goal of this research is to determine why household i chooses community j over community k . The conditional logit and mixed logit model compare the attributes of the chosen community to the attributes of the communities that were not chosen in the choice set to determine the significance of the explanatory variables. Maximum likelihood estimation is used to perform the analysis.

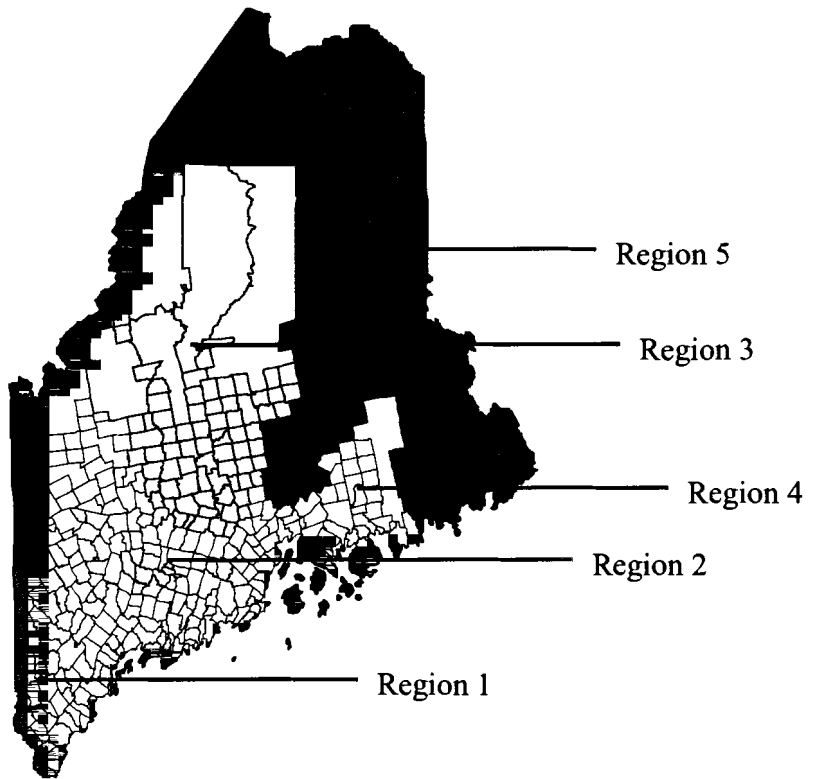
Two modeling specifications are examined here. The first examination models the choice of community solely as a function of community characteristics. We assume all households react similarly to the community characteristics regardless of individual characteristics such as age, income, and education level. This assumption may impose an artificial restriction on the behavior of households, but this model reveals the relative importance of location-specific attributes in a household's location choice. The first model is a conditional logit model.

The second model relaxes the assumption that households are homogeneous in their preferences. Specifically, income is interacted with quality of life attributes to explore the extent to which preferences for these attributes vary with income. This specification allows the theory that a household's preference for natural resource amenities increases with income to be tested. The second model is a mixed logit model.

To model the choice of one community over another, a choice set of communities for each household is required. It is not computationally feasible to estimate a choice set that includes all the municipalities in Maine. For the purpose of this analysis, choice sets of communities were randomly drawn from the region around the selected community. The state was divided into five regions. These five areas were based on the Maine Bureau of Labor and the Maine Housing Authority labor and housing market areas. The five regions include: (1) Southern; (2) Western; (3) North Central; (4) Mid Coast; and (5) Northeast (Figure 8).

A choice set of 20 municipalities was defined for each household. For in-state movers, the choice set includes the chosen community, the town of origin, plus eighteen other communities in the region. For out-of-state movers, the choice set is slightly different. Because the town of origin was not recorded for these movers, their choice set consists of the chosen town plus nineteen other communities in the region. Communities were randomly drawn from the set of communities located in the region of the selected community.

Figure 8. Five Moving Regions of Maine



Specification of the Conditional Logit Model

Given the available data and the assumptions, the first model specifies indirect utility as:

$$(8) \quad V_{ij} = \beta_1 \text{housingprice}_{ij} + \beta_2 \text{tax}_{ij} + \beta_3 \text{spending}_{ij} + \beta_4 \text{jobs}_{ij} + \\ \beta_5 \text{density}_{ij} + \beta_6 \text{CBD}_{ij} + \beta_7 \text{road}_{ij} + \beta_8 \text{school}_{ij} + \beta_9 \text{crime}_{ij} + \\ \beta_{10} \text{university}_{ij} + \beta_{11} \text{park}_{ij} + \beta_{12} \text{lake}_{ij} + \beta_{13} \text{coast}_{ij}$$

where V_{ij} denotes the observed portion of indirect utility derived by household i 's choice of community j . The variables price, tax, spending, and jobs are included to account for the fiscal variables associated with the community choice. Price represents the cost of locating in a community. Property tax and public spending are proxies for the cost and amount of local public services. The jobs to housing ratio is a proxy to identify if the area is a bedroom community, a mixed residential and commercial area, or a commercial area. Due to the collinearity and interdependence between the fiscal variables, the variable jobs was dropped from the final analysis.

The density and location variables (density, CBD, and road) are included to capture the rate of population density and proximity to economic and cultural opportunities as well as the major road network. The inclusion of the squared terms for these variables allows for greater flexibility in describing their effect. For instance, households may choose increasingly dense communities up to the point where the community becomes overcrowded and the density becomes a disamenity.

The school quality variable is anticipated to positively influence a household's location choice. The variables university and crime rate have been dropped from the final analysis due to a lack of significance. It is suspected that the lack of variation in the crime rates between Maine communities caused the variable's insignificance.

Maine is known for its thousands of lakes, its endless woods, and its spectacular coastline. These factors have been shown to be essential to tourism in

Maine. In this analysis, the role natural amenities play in the moving decisions of Maine movers is explored. Determining the importance of natural resource attributes may serve to guide local investment decisions and environmental policies for municipalities seeking to draw households and increase population. The natural resource variables (park, lakes, and coast) are examined to determine their impact and significance.

After a regression including all the movers in the sample, the sample of movers will be divided into two categories: those moving within Maine and those relocating to Maine from another state. This specification is motivated by Louis Ploch's work on Maine immigration (1988). We will determine if the quality of life variables are significant for out of state movers and if there is a significant difference in their importance between Maine residents and those relocating from another state.

Specification of the Mixed Logit Model

The specification of the mixed logit model entails creating interaction terms. The interaction terms enable the study of how a specific household characteristic influences the importance of a community characteristic. For this analysis, natural resource attributes are interacted with household income. The impact of income on the importance of these variables will be revealed. Of specific interest is whether or not a household's preference for environmental amenities increases with income. The specification of the mixed logit model is

the same as the conditional logit model (8) except for the addition of the interaction terms.

Given the data and the assumptions, the indirect utility function of the mixed logit model is specified as follows:

$$(9) \quad V_{ij} = \beta_1 \text{price} + \beta_2 \text{CBD}_{ij} + \beta_3 \text{CBD2}_{ij} + \beta_4 \text{road}_{ij} + \\ \beta_5 \text{road}_{ij}^2 + \beta_6 \text{school}_{ij} + \beta_7 \text{park}_{ij} + \beta_8 \text{lake}_{ij} + \beta_9 \text{coast}_{ij} + \\ \beta_{10}(\text{park}_{ij} * \text{income}_i) + \beta_{11}(\text{lake}_{ij} * \text{income}_i) + \beta_{12}(\text{coast}_{ij} * \text{income}_i)$$

If demand for quality of life attributes has increased due to an increase in median incomes as suggested in Chapter 1, it follows that interaction terms comprised of income and quality of life attributes will be significant. Higher income households are expected to be more likely to choose communities rich in natural amenities than lower income households. Therefore, the interaction terms (park*income), (lake*income), and (coast*income) are expected to be positive.

Chapter 6

RESULTS

In this chapter, the results for the conditional logit model and the mixed logit model are reported. Three versions of the conditional logit model were estimated using the same explanatory variables with three different samples, a pooled sample of all the movers, a subset of Maine movers, and a subset of movers that relocated from out of state. In the conditional logit models all the explanatory variables vary across communities but not across households. In the mixed logit model some variables vary across communities and some vary across households. It must be noted that the parameter estimates in these discrete choice models are not the marginal effects. Rather, the parameters represent effects on contrasts between pairs of communities, not the effects on the probability of a community being chosen (Allison 1999). The sign and significance level of the parameter estimates are informative.

The Conditional Logit Model

Numerous specifications were estimated. Initially, a model with only the community's price, location, and local amenities (median house value, distance variables, and quality of life and natural resource attributes) was specified (density, property tax, and per capita spending were left out) (Model 1). The resulting coefficient estimates are consistent with expectations and economic theory (Table 5). The parameter estimate for price was negative indicating that housing is a normal good and that increases in housing prices in a community decrease a household's

probability of choosing that community. The parameter estimates for the distance variables were negative for the monomial terms and positive for the quadratic terms indicating the diminishing marginal returns of proximity to a central business district or a major roadway. These findings are consistent with the monocentric model of urban economic theory (e.g., Alonso (1964) and Muth (1969). The estimates for community-specific amenities (school, park, and coast) are positive and significant. This result supports the Tiebout theory of residential location choice that states households “shop” for the community that provides the most preferred bundle of public goods (Tiebout 1956). The significance of the quality of life variables (school, park and coast) also support the theory in Chapter 1 positing the increased importance of quality of life variables in a household’s location choice (e.g., Deller 2001; Graves 1983).

The insignificance of the variable lakes is not particularly surprising for several reasons. First, the state of Maine has thousands of lakes. A lack of variation in lake surface area across the communities of the state may be contributing to the variable’s insignificance. Second, lake surface area may not be the relevant measure. Finally, the abundance of lakes in the state of Maine may make the presence of a lake in one’s community unimportant to a household’s community choice.

A second specification was estimated that includes the above variables and the property tax and per capita spending variables (Model 2). The parameter estimates for the location and quality of life variables largely remained the same with the exception that the total surface area of lakes became significant and positive. The price variable remained negative but became insignificant ($p=0.18$).

Table 5. Regression Results for the Conditional Logit Models

Variable	Model 1	Model 2	Model 3
Price	-0.008*** (14.97)	-0.007*** (8.54)	0.008*** (8.03)
Tax		0.740*** (72.22)	0.768*** (62.77)
Spending		0.0003*** (11.85)	-0.0001** (4.43)
Density			8.87*** (107.26)
Density ²			-6.97*** (71.96)
CBD	-0.058*** (97.76)	-0.041*** (45.32)	-0.006 (0.57)
CBD ²	0.0003*** (22.96)	0.0002*** (8.71)	-0.00003 (0.22)
Road	0.048*** (41.83)	-0.042*** (32.67)	-0.016* (3.99)
Road ²	-0.0003*** (17.02)	0.0002*** (12.91)	0.0001 (1.07)
School	3.702*** (25.53)	3.544*** (21.28)	1.88** (4.83)
Park	1.867*** (22.20)	1.400*** (11.41)	1.33*** (5.32)
Lake	0.002 (1.15)	0.004*** (5.31)	0.01*** (16.73)
Coast	0.922*** (43.75)	0.873*** (36.84)	0.43*** (7.73)
Log-Likelihood	-1447.5	-1412.47	-1353.53
AIC	2913.27	2846.93	2733.60
Number of Obs.	12040	12040	12040

* denotes significance at .10%

** denotes significance at .05 %

*** denotes significance at .025%

Chi-Square Statistics are in parenthesis

The insignificance is most likely due to a correlation between the median house value and the property tax and per capita spending variables. The estimate for per capita spending is positive but insignificant.

The surprising result of this model is the coefficient estimate for property tax is positive and significant. This suggests the unlikely case that households prefer higher property tax rates. There are numerous possible explanations for the positive and significant estimate for the property tax variable. First, the property tax variable may be picking up the effect of variables omitted from the model. Second, many of the households in the sample chose suburban communities outside the urban centers in the state. In many of these communities, property tax rates have risen, as new public services are required. Endogeneity is a potential complicating factor here, as new residents may actually result in higher property tax rates. The use of the property tax rate from later in the study period may be problematic.

The parameter estimates for the natural resource amenities (park, lakes, and coast) are significant and positive, as is the parameter estimate for school quality. Again this model supports the Tiebout theory of community choice and, further, it demonstrates that movers in Maine value natural resource amenities and consider natural resources when selecting residential communities.

Finally, in the last specification (Model 3), the density variables (density and density²) are added into the model. The inclusion of these variables created unexpected results. The property tax variable remained positive and significant and the per capita spending coefficient became negative and significant. The price coefficient became positive and significant. The parameter estimate for density is

positive and the parameter estimate for the quadratic density term is negative; both variables are significant. The distance variables became insignificant while the natural resource variables maintained their significance and signs (positive). The parameter for school quality also remained positive and significant.

The Strength of The Models

When analyzing the log-likelihood ratios and the AIC statistics for the three regressions, the third specification (Model 3) appears to be the best fit. However, economic theory tells us the signs of the explanatory variables price, property tax, and per capita spending are incorrect. Therefore, it is suspected that the variables may be representing something other than what is intended. In such circumstances, the results are flawed. The results of the first model (Model 1) explain residential choice in a way that is consistent with economic theory. Accordingly, the first model is used for the comparison of in-state and out-of-state movers.

A Comparison of the Movers

There is little difference in the estimated coefficients between the pooled sample of movers and the sample of in-state movers (Table 6). All of the parameter estimates are significant except for the parameter estimate associated with lakes. In contrast, there are greater differences between the pooled sample and out-of-state movers. Not only is the coefficient for lakes insignificant, the coefficients for price and school quality are insignificant as well.

Table 6. Results of the Conditional Logit Model for the Pooled Sample, In-State Sample, and Out-of-State Sample of Movers

Variable	Pooled Sample	In-State Sample	Out-of-State Sample
Price	-0.008*** (14.97)	-0.011*** (21.20)	0.0001 (0.001)
CBD	-0.058*** (97.76)	-0.063*** (85.67)	-0.041*** (9.97)
CBD ²	0.0003*** (22.96)	0.0003*** (16.28)	-0.0003** (4.44)
Road	0.048*** (41.83)	-0.043*** (26.58)	-0.070*** (17.17)
Road ²	-0.0003*** (17.02)	0.0002*** (9.80)	0.0004*** (7.45)
School	3.702*** (25.53)	4.36*** (28.56)	2.19 (1.63)
Park	1.867*** (22.20)	1.695*** (13.93)	2.30*** (8.01)
Lake	0.002 (1.15)	0.002 (1.65)	0.0005 (0.01)
Coast	0.922*** (43.75)	0.890*** (32.63)	1.29*** (14.07)
Log-Likelihood	-1447.5	-1128.08	-301.95
AIC	2913.27	2274.171	621.897
Number of Obs.	12040	9600	2440

* denotes significance at .10%

** denotes significance at .05 %

*** denotes significance at .025%

Chi-Square Statistics are in parenthesis

These results suggest that natural resource amenities are important to both in-state movers and out-of-state movers. Again, this finding supports the theory of an increased demand for natural resource amenities and, further, these results support the findings of Louis Ploch (1989) who reported that out-of-state movers were moving to Maine for its quality of life. The lack of significance of school quality in the location decision of out-of-state movers supports the findings of previous studies that suggest local public services are less significant to the moving decisions of long distance movers than of short distance movers (Dahlberg and Frederiksson 2000). This lack of significance is thought to be due to a lack of information rather than a lack of importance to the household. In addition, long distance movers may not have the option to be as selective as short distance movers (Dahlberg and Frederiksson 2000).

The Mixed Logit Model

The theory discussed in Chapter 1 suggested location-specific natural amenities have become increasingly important in location choices due to increased incomes nationwide (e.g., Graves 1983; Greenwood et al 1989). To investigate this theory with the sample data, household income was interacted with the location-specific natural amenities variables (parks, lakes, and coast). Three interaction terms were created: (park*income), (lakes*income), and (coast*income).

First, the mixed model was estimated with both the natural resource variables and the interaction terms included. The interaction term coast*income was significant but the variables coast, park, and lake became insignificant at a 95 percent level of certainty. Both the interaction terms lake*income and park*income were

insignificant. Then, the mixed model was estimated including only the interaction terms (the natural resource variables were dropped). This improved the AIC score from 2565.523 to 2562.553, which indicated a better fit. However, this specification imposes a restriction on the model by allowing the natural resource variables to influence a community choice only when they are considered with a household's income. The results suggest that an increased income increases the importance of both parks and the coast on a household's location decision. The interaction term for lakes*income was insignificant and suggests a household's income does not affect the importance of lake surface water to the household's community choice.

The results of the mixed logit model are consistent with the theory presented in Chapter 1 (e.g., Graves 1983; Porell 1982). A household's income appears to significantly influence the importance of the natural amenities in the choice of community. The parameter estimates suggest that as income increases the probability of choosing a community on the coast increases. The results also suggest that as income increases the probability of choosing a community with greater amounts of parkland increases. The implications of these findings are discussed in the following chapter.

Limitations of the Study

While the results of this analysis are encouraging, it is important to note the limitations of this work. First, the analysis could be improved greatly by increasing the quality of the secondary data used in this analysis. Additional municipality-level data could be pulled together to better represent the factors affecting residential

location decisions. Second, a nested logit framework may enable a richer representation of the location decision.

Chapter 7

DISCUSSION AND CONCLUSIONS

The results summarized in Chapter 6 provide several insights regarding the location preferences of Maine residents. First, the results indicate that quality of life attributes are significant to a household's choice of community. The results support Tiebout's hypothesis that households "shop with their feet" (Tiebout 1956). Public and private amenities are relevant to the location decisions of Maine residents. The significance of the quality of life attributes is consistent with the findings of recent migration studies (e.g., Greenwood, Chalmers, and Graves 1989; Mueser and Graves 1995). Understanding the preferences of Maine households enables policy makers to ensure these residential location demands are met in economically and environmentally sound ways. Further, this understanding may assist in the development of policies to manage natural resources and capitalize on the increased demand for quality of life attributes in residential locations.

School quality had a consistently positive and significant influence in the model specifications, suggesting that increasing the quality of public schools in a given community may increase the probability that households choose that community as a residential location. In turn, increasing school quality may decrease the probability that households migrate from a given community. This finding is important for communities seeking to maintain current residents and attract new residents.

Similarly, the presence of public parks and conservation land increased the probability that a community was selected, *ceteris paribus*. Urban centers in Maine, especially those where population has been declining, may maintain and attract residents by preserving and possibly increasing the area of conservation land and parks within their boundaries. This finding is consistent with Wu (2001) who suggested that the pattern of urban sprawl might be reduced by providing higher levels of natural amenities in urban centers. This finding also highlights the role of land-use planning organizations and conservation groups in providing amenities to community residents.

The probability of a household choosing a community as its residential location increases, *ceteris paribus*, if the community is located within ten miles of the coast. The policy implications of this finding are limited because a community cannot change its distance from the coastline. However, a community can protect its beaches and coastline to maintain its attractiveness to households.

The second insight gained from this analysis is that income appears to affect positively the influence of natural amenities. The results of this analysis support the hypothesis that demand for natural amenities increases with higher incomes. Income has a significant and positive impact on the likelihood of choosing a community located within ten miles of the coast. Further, the importance of parkland in a community choice increases as household income increases. These findings support the hypotheses put forth by such researchers as Graves (1983) and Porell (1982).

Finally, a comparison of the in-state and out-of-state movers indicates some interesting difference in residential location preferences across these groups of Maine residents. However, similarities exist between the two groups of movers. Both groups value natural resource amenities (parks and coast). This finding again supports the hypothesis of an increased demand for natural resource amenities and the hypothesis of Louis Ploch (1988).

The findings suggests that the state of Maine, rich in natural amenities, may capitalize on this increased demand by promoting its natural resources and quality of life characteristics. By doing so, the state may attract new residents and new businesses to locate in Maine. An influx of new households and businesses is likely to increase the economic activity within the state. The increased demand for natural amenities in location decisions enables the state of Maine to capitalize on its natural resources without depleting its resource stock. The recognition of this demand for natural amenities promotes the protection and sustainability of Maine's natural resources.

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BIOGRAPHY OF THE AUTHOR

Michele Ann McMahon was delivered by her grandfather, Dr. Frank J. Brown at the Point Pleasant Hospital in Point Pleasant, New Jersey on April 27, 1973. She grew up in Toms River, New Jersey. She received her Bachelor's degree in Economics from the University of Delaware in May of 1995. Michele has traveled extensively with her friends and family visiting such places as Ireland, Costa Rica, Mexico, and numerous Caribbean Islands. After college she traveled throughout the United States visiting almost every state in the country. She moved to Portland, Oregon in 1996 and resided there until 2000. She moved to Maine in 2000 to enter the graduate program of the Resource Economics and policy Department at the University of Maine. Michele is a candidate for the Master of Science degree in Resource Economics and Policy from The University of Maine in December, 2002.